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Substrate Smoothing Using Gas Cluster Ion Beam Processing

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Abstract:

In order to smooth a wide variety of surface material types to within an angstrom of roughness without subsurface damage, a beam energy equivalent to the individual bond energy of the surface atoms would be required. This would ideally preserve the integrity of the underlying material matrix and eliminate both high and low frequency surface aberrations. A low energy ion beam of a few hundred eV would be difficult to produce with significant intensity, however, due to the space charge effect encountered from the increase in density of the ions produced ("beam blow-up"). The use of a gas cluster ion beam (GCIB) process, however, has proven to provide an effective atomic smoothing on numerous material surface compositions without causing subsurface damage.¹⁻³ This paper provides a description of the recently developed GCIB surface smoothing and modification apparatus, a discussion of the mechanism for surface smoothing, and provides a focus on thin film Si, SiC, and semiconductor-on-insulator (SOI) material results.

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